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Growth and Fate of Comandra Rust Cankers on Young Lodgepole Pine

Forest Service U.S.D.A.
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GROWTH AND FATE
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COMANDRA RUST CANKERS
ON
YOUNG LODGEPOLE PINE

by

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INTRODUCTION

Comandra blister rust, caused by the fungus *Cronartium comandrae* Pk., poses a major problem to lodgepole pine, *Pinus contorta* Dougl. ex Loud., management throughout the Rocky Mountain Region. In Colorado and Wyoming growth loss and mortality caused by the rust is probably second only to that caused by lodgepole pine dwarf mistletoe, *Arceuthobium americanum* Nutt. ex Engelm.

Comandra rust was collected as early as 1906 in Colorado on lodgepole pine (Krebill 1965) and 1914 in Wyoming (Andrews and Harrison 1959); however, widespread damage was not known in the Rocky Mountain states until the mid-1950's when reported by Mielke (1957) in Idaho, Utah and western Wyoming. Peterson (1962) and Krebill (1965) indicate much current damage is from an epidemic between 1910 and 1945. Extensive outbreaks of the rust occur only rarely because of the complex series of climatic and biologic events necessary for large scale infection (Krebill 1968).

The highest concentration of rust incidence and damage observed in the Rocky Mountain Forest Service region is along the upper Wind River drainage on the Shoshone National Forest. Current disease loss consists primarily of spike tops, growth loss, and mortality in pole- to sawtimber-size trees (Fig. 1). Data collected by Brown (1977) for 21 plots describes ranges in rust incidence on plot trees from 15.7 to 73.9 percent, spike top condition from 15.7 to 69.3 percent and tree mortality from 1.0 to 29.4 percent.

The rust attacks trees of all sizes and ages. Mortality in seedlings and saplings occurs more rapidly than in older trees, which may take 50 or more years to die. Infection in pole- and sawtimber-size trees results in losses which postpone economic maturity of infested stands (Krebill 1975). Proximity of lodgepole stands to comandra plants, the alternate host for the rust, may directly influence severity of infection (Krebill 1965). In many stands the heaviest amounts of infection occur near the edge of stands and on open-grown trees adjacent to comandra habitat.

Current control recommendations for the rust are directed at reducing the number of heavily-infected trees in stands rather than at preventing infection. Management guidelines recently have been developed for infested stands (Brown 1977). One option is to salvage or cut the most heavily infested stands while the trees are still useable. Brown (1977) presents criteria for leave tree selection. In addition, pruning infected branches may be useful to prolong the life of high value trees.

Additional information is needed on the growth rate and the effect of comandra rust cankers on seedling- and sapling-size lodgepole pine to permit formulation of management guidelines for young infested stands. Rhoads (1920) working with eastern white pine in Maine, made growth measurements over one growing season. He found canker growth rate almost directly proportional to branch diameter and related to time of year. Buchanan (1938) also found canker growth increased with branch diameter; however, he stated factors other than branch diameter exerted considerable influence on canker growth. This study was initiated to study the effects of the rust in a young lodgepole pine stand.

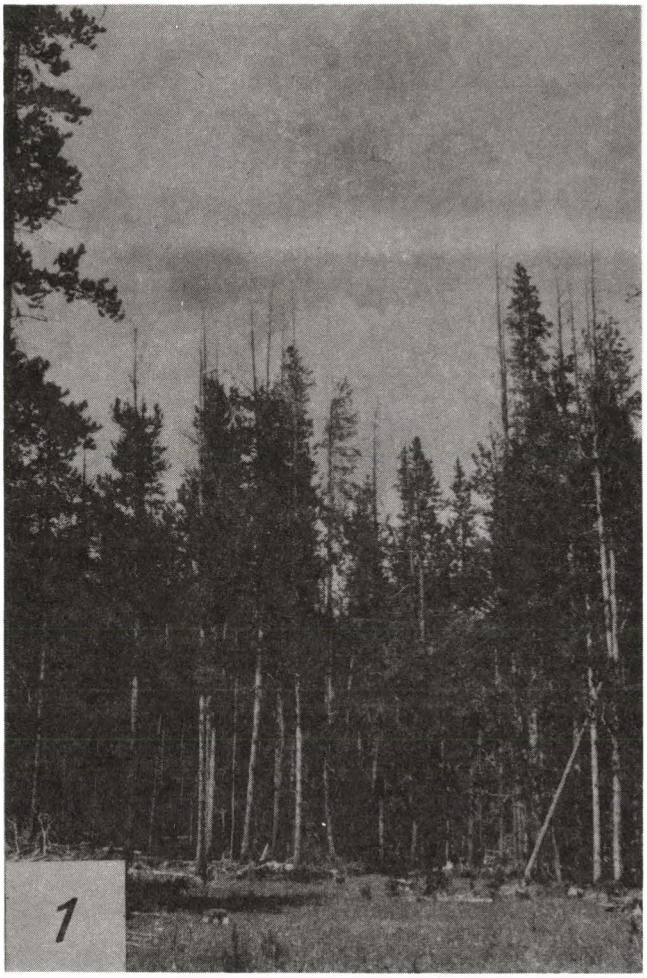
STUDY AREA AND METHODS

During August 1973 a 15-year-old lodgepole pine stand (average d.b.h. 2.2 inches) located in Lava Creek (Sheridan Creek compartment 16, sub-compartment 9, stand 4) on the Wind River Ranger District, Shoshone National Forest, was selected for study (Fig. 2). A tree near the edge of the stand was selected as a starting point to reference the study plots. The reference tree and study plot trees were marked with orange paint. Nine circular plots (0.01 acre), containing 49 living, rust-infected trees (average 544 infected trees per acre) referenced by compass bearing and distance from each plot center (a stump or pile of painted rocks), were established. Each tree was marked on the bole at eye level with orange paint and identified by a numbered, yellow, plastic tag attached to a live branch.

Tree data including condition, d.b.h., and height, as well as canker location, size and condition (active, inactive, sporulating) were recorded so each canker could be readily located during subsequent examinations. Cankers were classified as live or dead depending on the presence or absence of typical symptoms and signs of the disease (resin exudation, spore production). In addition to the nine circular plots, 32 other trees were located within the stand and similar data collected. All study trees were examined in 1973, 1976, and 1978. Trees were repainted in 1975 and 1978 as needed.

Figure 1. Pole-size lodgepole pine stand on the Wind River Ranger District, Shoshone National Forest showing spike tops caused by comandra blister rust.

Figure 2. Sapling-size lodgepole pine with branch and trunk infection caused by comandra blister rust. Note swollen branch at center of trunk canker and aecial production near canker margin (arrows).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RESULTS AND RECOMMENDATIONS

Average diameter increment was 0.89 inches and average height increase was 4.9 feet for all living trees for the 5-year period. A summary of the status of the 81 living trees and branch and stem infections over the 5 year period is presented in Table 1. Nineteen trees have died since 1973 due to girdling stem cankers. The number of live branch and stem infections decreased by 56.4 and 41.9 percent, respectively (Table 1). Ninety-five percent of the cankers were located within 30 inches of ground level. The average canker was located 8.3 inches from the trunk. Measurements were made from the center of each canker because of the difficulty in determining the proximal extent of the infections. Estimated age of infections ranged from 9 to 18 years with the majority 13 to 18 years old. All infections classified as stem cankers in 1978 were traced to branch infections originating within 8 inches of the stem (Table 2). Figure 3 provides a means for estimating the probability that a canker located a certain distance from the trunk will reach the trunk. The regression equation ($r = 0.95$) $Y = 110.27 - 11.49\ x$ expresses this relationship, where Y = probability and x = distance from canker center to trunk. Growth measurements of active branch infections indicated average rate of growth along branches was 0.7 inches per year. Diameter of branches was not recorded; thus, it was not possible to determine the effect of branch diameter on canker growth rate.

Forty-seven percent of the cankers were classified as inactive in 1978 (Table 2). *Tuberculina maxima* Rost. may have played a role in the death of some of these cankers (Powell 1971), since the fungus was noted in 1973 and 1975 on some cankers. Of 74 cankers sporulating in 1973, only 33.8 percent were sporulating in 1978.

Death of cankers may also have resulted from rodent feeding and shading of branches. In 1978 rodent feeding was noted on 34 percent of the trees; some feeding occurred on cankers. Mielke (1957) similarly reported rodent feeding on comandra rust cankers.

This study has provided some information on the fate of comandra rust branch cankers on sapling-size lodgepole pine in western Wyoming. Although some information is presented on canker growth rate along branches, additional work is needed on the influence of branch diameter on growth rates.

Specific guidelines for comandra rust-infested seedling and sapling stands cannot be developed from the results of this study. Additional work is needed to determine effects of various

TABLE 1. Five-year summary of living trees, live and dead branch infections, and live stem infections caused by comandra rust on lodgepole pine, Wind River Ranger District, Shoshone National Forest

Living trees			Live branch infections			Dead branch infections			Live stem infections		
1973	1978	Percent change	1973	1978	Percent change	1973	1978	Percent change	1973	1978	Percent change
81	62	- 77	55	31	- 56	16	42	+ 262	31	13	- 42

TABLE 2. Number of comandra rust branch cankers on lodgepole pine which reached trunk, died enroute, or were still enroute to trunk, Wind River Ranger District, Shoshone National Forest, 1978. Arranged by canker-to-trunk distance in 1973.

Original canker-to-trunk distances (inches)	Total cankers	Canker reached trunk by 1978	Canker died enroute to trunk	Canker still enroute to trunk in 1978
		Number		
1	4	4	0	0
2	6	5	1	0
3	8	7	0	1
4	2	1	1	0
5	16	10	5	1
6	12	3	9	0
7	8	4	3	1
8	8	1	7	0
9	4	0	4	0
10	2	0	2	0
> 10	4	0	3	1
TOTALS	74	35	35	4

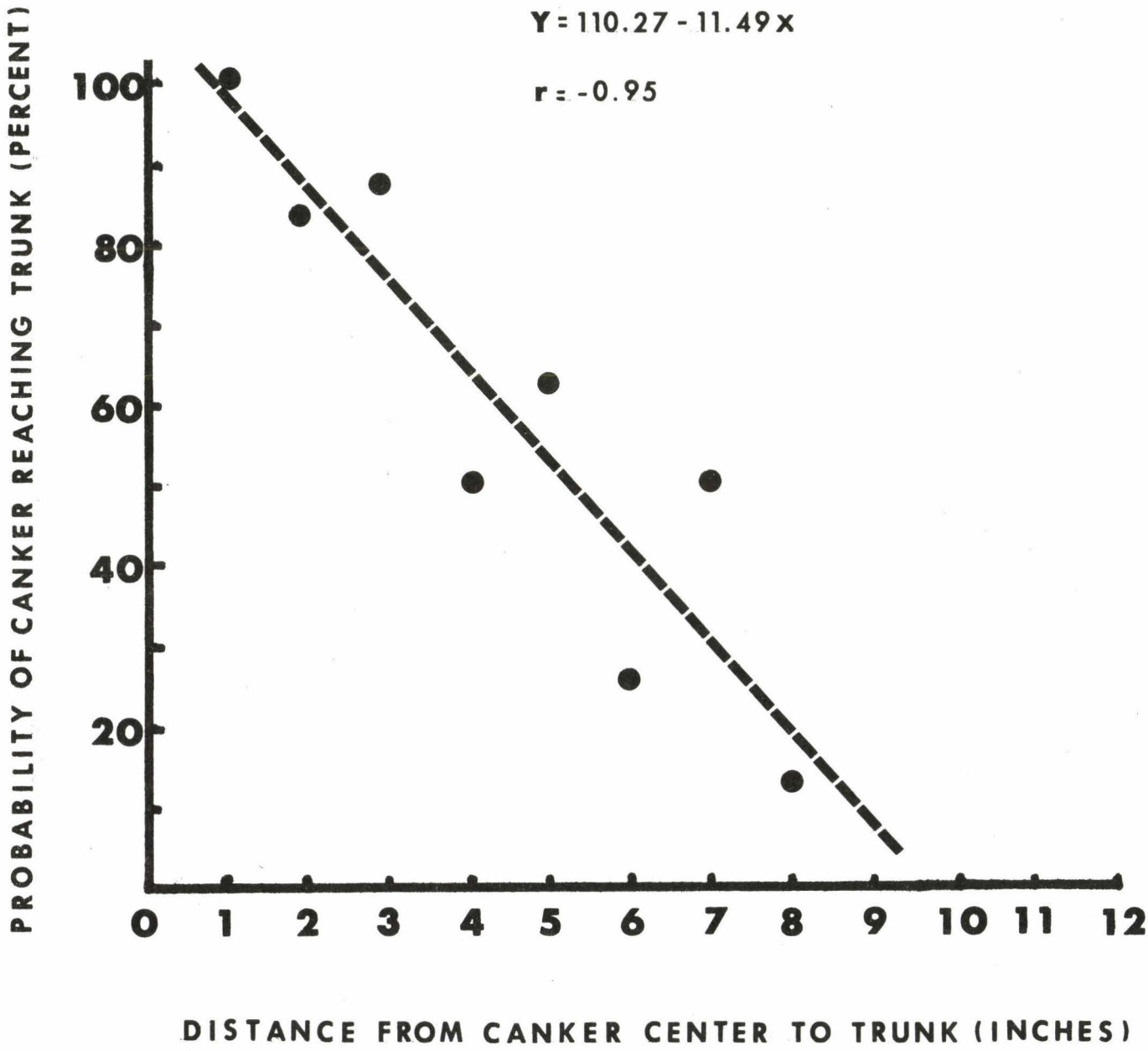

Figure 3. Probability of comandra blister rust branch canker reaching trunk in relation to distance from trunk.

infection levels of the rust on tree loss and subsequent stocking levels in young stands. Low incidence of the rust in young, dense stands may result in a light thinning, whereas in marginally stocked stands the disease may cause significant losses. In older stands the land manager should discriminate against infected trees during timber stand improvement operations. Harvesting should be concentrated first in those stands where infection rates are reducing tree density below a desired level. Pruning infected branches may be useful to prolong the life of high value trees. Any branch canker within 10 inches (measured from the center of the canker) of the trunk should be pruned to reduced the probability of stem infection.

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